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FINAL REPORT OF THE COMMITTEE ON SANITARY DRINKING FOUNTAINS OF THE IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION[1]

Introduction. The war against the common drinking cup has been won. This victory, however, must not be allowed to blind us to the dangers lurking in the usual substitute for the common drinking cup, the so-called sanitary drinking fountain. With amazing rapidity these bubbling fountains have invaded our public streets, our schools, our libraries, our playgrounds and our hotels. Approved by public health authorities of high standing and by journals of wide circulation, the bubbling drinking fountain has met little or no opposition until very recently. Within the past few years, however, several elaborate series of laboratory experiments have been made upon most of the prevailing types of bubbling fountains. These experiments, supplemented by its own observations, have led your committee to the following conclusions.

Conclusions. 1. All types of drinking fountains with vertical jets are to be condemned.

2. Most types of drinking fountains with slanting jets are to be condemned.

3. To be sanitary, drinking fountains should conform to the following specifications:

a. The jets shall be slanting.

b. The orifices of the jets shall be protected in such a manner that they cannot be touched by fingers or lips, or be contaminated by droppings from the mouth, or by splashings from basins beneath the orifices.

c. The guards of the orifices shall be so made that infectious material from the mouth cannot be deposited upon them.

d. All fountains shall be so designed that their proper use is self-evident.

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[1] Read and adopted at the annual meeting of the Iowa Section at Mason City, October 23, 1919. Discussion of this report is requested and should be sent to the Editor.

These conclusions are based, first, upon observations of public fountains while in use and, second, upon bacteriological investigations of public fountains under laboratory conditions.

Observations of public drinking fountains while in use. The following quotation from the Detroit *Journal* is taken from a clipping sent out by one of the manufacturers of drinking fountains. It purports to be part of a warning issued by the Michigan State Board of Health.

> Statistics gathered by a federal inspector in a railway station show what may happen. He found 47 persons used the fountain in an hour. Of these, 11 were men, 22 women and 14 children. But in almost every instance, he reports, the lips were placed completely around the metal ball from which the water spurted and one small boy acted as though he were trying to swallow the whole machinery. Of the 47 people, four were colored, three looked as though they were unmistakedly victims of tuberculosis, and three had eruptions on their face.

In its progress report read in 1917 at Council Bluffs at the third annual meeting, your committee reported the following results of its observation of the use of two fountains without mouth guards. One fountain was of the continuous-flow type with a bubble ⅝ inch in height. It was located in a public library. During the period of observation, 59 persons drank from this fountain, 22 of whom were children and 37 adults. Of the 22 children, 15 placed their lips upon the metal top of the bubbler, while only 7 did not. Of the 37 adults, 28 placed their lips upon the metal top, while only 9 did not. One adult had an eruption upon the face and one was apparently in bad general health.

The second fountain was of the intermittent-flow type with a bubble ¾-inch in height. It was located at a street corner. During the period of observation, 43 persons drank. One was a small child which had to be held up in order to drink. This child placed its lips upon the metal top of the bubbler. Of the remaining 42 persons, 18 were children and 24 adults. Ten of the 18 children placed their lips upon the metal top, while 8 did not. One of these children was apparently in bad general health. Nine of the 24 adults placed their lips upon the metal top while 15 did not.

A thorough investigation of methods used by drinkers has been made by Dr. J. J. Kinyoun and Dr. Louis V. Dieter, under the direction of the Drinking Fountain Committee of the Health Department of the Commissioners of the District of Columbia. In observations of the methods used by 1500 to 2000 drinkers from practically all types of fountains, these observers were greatly impressed by the large proportion of persons who cannot drink from a bubbling fountain unless they grasp the nozzle with the lips. Certain individuals with large redundant lips are able to reach down beyond the guard, which is placed on some of the bubblers, and grasp the nozzle with the lips in spite of it. Where they are not successful in the attempt to grasp the nozzle with their lips, they do succeed in bringing their lips near enough to the nozzle to allow drippings from the mouth to fall upon it. Moreover, the guards which are being placed on the new type of slanting jet fountain usually consist of projections so placed that the upward flow of the water, as it describes its arc, passes very close to the edge of the guard. Actual observations show that at least 40 per cent of the drinkers place their mouths directly on the guard, and by thrusting their heads in the direction of the nozzle not only allow drippings from the mouth to flow over it, but also seriously contaminate the guard itself with mouth organisms.

Furthermore, these observers call attention to the frequent contamination of the nozzles of fountains by the hands and fingers. In observations made in schools and playgrounds, the conclusion was reached that nearly 50 per cent of the children, particularly boys, play with the fountains in an attempt to squirt one another, or otherwise amuse themselves. Moreover, the child is not the only offender in the contamination of the nozzle with the fingers, for adults have been observed to wipe the nozzle carefully with their dirty hands and then grasp the nozzle with their lips while drinking.

The following quotation from an article by Dr. Dieter, soon to be published, indicates the dangers resulting from finger contamination.

> That the danger from finger contamination was not hypothetical but a proven fact, was shown by a series of tests made in the schools during the recess period, when we isolated, besides other organisms, in six instances the Bacillus coli, an organism whose normal habitat is the intestinal canal. The significance of the finding of this organism on the nozzles, that had been free from it immediately preceding the test, lies in the possibility of communicating typhoid in this manner from carriers. That we did find this organism was as might have been expected, considering the fact that some of the children make a dash directly from the toilets to the drinking fountain and commonly finger the nozzle in play even before drinking. Furthermore, how many children's fingers are free from germ-laden mucus from the nose and from the mouth, even more dangerous as a general rule than other impurities?

In connection with the tests made under practical conditions, following the use of these fountains by drinkers, we have isolated mouth bacteria in all instances, principally streptococci, pneumococci, an organism morphologically identical to the influenza bacillus and in three instance an organism having all the microscopic characteristics of the diphtheria bacillus. There is no doubt that, from the physical appearance of some of the drinkers we have observed, we could have isolated the bacillus of tuberculosis, or the organism responsible for syphilis, had it been possible to do so with our present methods for the cultivation of these organisms. Swab cultures made from the guards that were brought in contact with the lips of persons during the process of drinking, on some of the side-stream types, showed the presence of mouth organisms in nearly all instances.

Results of bacteriological experiments on public drinking fountains under laboratory conditions. Nozzles of drinking fountains now on the market may be classified as follows:

A. Vertical jet nozzles.

1. Nozzles consisting of bowls which do not drain out, with the result that the incoming jet passes through the water in the bowl.
2. Nozzles consisting of bowls which fill with water when in use, as in class 1, but which drain out more or less quickly when used intermittently.
3. Nozzles with perforations, or slits, or one single outlet, with free overfall for waste water. The incoming jets do not pass through cups or bowls of water.

B. Slanting jet nozzles.

1. Nozzles with a series of holes so arranged around the periphery of a horizontal circle that the separate jets from the holes impinge and produce a bubble in the center.
2. Nozzles throwing a single slanting jet at an angle with the vertical.

Under each of these classes are many different types, any of which may be arranged for either intermittent or continuous flow. Fortunately the laboratory tests now on record include practically all of the types of the various classes.

The earliest published laboratory tests on bubbling fountains are those of Jane L. Berry of the Bureau of Laboratories of New York City. She experimented with but a single type of fountain, having a vertical jet and a cup which could not be drained when in use, through which the incoming jet came. It is interesting to note that the manufacturer had invented an arrangement by which the cup could be drained when in use, but he did not recommend the arrangement, because the dry cup would accumulate dust which might not readily wash out and secondly, because the full cup is a necessary preliminary before the bubble effect can be obtained, and is the best safeguard against too strong an upward current when the water is first turned on. These ideas probably account for the popularity of this type of fountain with both manufacturers and drinkers.

In testing the fountain a broth culture of coli communis was rubbed on the lip of the empty cup and then recovered in considerable numbers later in the bubble. Similar results were obtained when the coli communis culture was applied to the inside surface of the bottom of the empty cup.

The next experiments that are on record are those by Pettibone, Bogart and Clark of the Laboratory of Medical Bacteriology of the University of Wisconsin. The immediate occasion for starting these investigations at the University of Wisconsin was an epidemic of streptococcus tonsillitis which occurred in the fall of 1914 in one of the women's dormitories. In seeking to find the source of the spread of this epidemic, the drinking fountains were examined and found to be heavily contaminated with streptococci. Subsequent to this, the bubble fountains on the campus of the University of Wisconsin were investigated. On one occasion 43 out of 77 bubble fountains, or about 56 per cent, were found to be contaminated with streptococci. On a second occasion, 35 out of 50 fountains, or 70 per cent, were found to be contaminated with streptococci. As a result of their bacteriological tests, these experimenters formulated the following conclusions:

1. During an epidemic of streptococcus tonsilitis in a women's dormitory of the University of Wisconsin, streptococci were found in the bubble fountains in this building and in the water issuing from these fountains.
2. The city water supply was at the time, and has been, excellent in its sanitary character. It is obtained from the underlying Potsdam sandstone. No streptococci were found in a Berkefeld filter through which water had been flowing continuously for one week.
3. Presumably the bubble fountains were a factor in transmitting the disease.
4. A survey of all the fountains of the University showed the presence of streptococci in over 50 per cent of the total number. The streptococci varied in abundance from a few chains to an almost pure culture obtained by swabbings from the fountains of the women's dormitory.
5. In an experimental bubble fountain, B. prodigiosus when introduced either by means of a pipette or by the moistened lips, remained in the water from 2 to 135 minutes, depending partly on the height of the bubble.

6. Most of the organisms are flushed away, but some remain dancing in the column much as a ball dances on the garden fountain, even though the bubble is increased to the impractical height of 4 inches.

7. To avoid the difficulty always present in the vertical column, a simple fountain with a tube at an angle of fifty degrees from the vertical was constructed. B. prodigiosus was never found in the plates from this type of fountain even when samples were taken immediately after the introduction of the organisms.

8. We believe that this type of fountain should be generally adopted. Its simplicity, low cost of construction and freedom from lurking dangers should recommend it to all.

In 1917, H. A. Whittaker, Director, Division of Sanitation, Minnesota State Board of Health, published the results of an investigation of the drinking fountains of the University of Minnesota. He found that of 77 drinking fountains of 15 different types, 80 per cent were contaminated with streptococci. His results may be summarized as follows:

1. Eighty per cent of the fountains were infected with streptococci, which it is reasonable to assume came from the mouths of the consumers, as these organisms were not found in the water supplying these fountains.

2. Streptococci were actually present in the water discharged from 11 per cent of these fountains, and therefore could be transmitted to the mouth of the drinker even though the lips were not touched to the infected parts.

3. The principal defect in construction of the fountains was thought to be the vertical discharge of the water, which could be corrected by employing the principle of the slanting jet.

The conclusions of these experiments have been confirmed beyond all doubt by the remarkably thorough and exhaustive series of laboratory tests made by Dr. Kinyoun and Dr. Dieter. These experiments are soon to be published. Through the courtesy of Dr. Dieter, who has furnished the committee with an advance copy of his report, and through the kindness of I. M. Cashell, city manager of Goldsboro, N. C., who has supplied the committee with a copy of the official report of Major Kinyoun, the following summary has been made possible.

The experiments of Dr. Kinyoun and Dr. Dieter were started something over four years ago. Since then, ninety separate and distinct types have been tested in the laboratory, including about eight or ten so-called slanting jet types. These tests have shown conclusively that in all types of vertical jet drinking fountains bacteria, when introduced in the bubble, remain in the stream for several minutes. An attempt was made to determine the reason for the presence of the bacteria in the stream for so long a time when the cultures were poured directly on the bubble. It was concluded that while this was due to some extent to the organisms dancing up and down on the crest of the bubble, yet it was a much more important fact that there seem to be differences in the velocity of the water in the center and in the periphery of the stream, so that some of the bacteria are carried down toward the nozzle in an eddy. Particularly was this true in the case of mouth washings containing more or less viscous sputum, which when carried down to the nozzle, became attached to it in threads. Small particles of it together with bacteria would be washed up into the bubble for a considerable length of time.

Furthermore, these experiments prove that most of the slanting jet fountains do not come up to the standard specifications above suggested. The main trouble is faulty protection of the nozzle or the guard from finger or mouth contamination. It was clearly demonstrated, however, that bacteria, when introduced at the crest of the bubble of the slanting jet, would be immediately carried away. In this respect, slanting jet fountains are safe. When the nozzle and the guard are properly protected and constructed, such a fountain can be approved without hesitancy.

Recommendations: In view of the fact that all vertical jet drinking fountains are a menace to the public health comparable with the common drinking cup, and in view of the fact that most slanting jet fountains are not being designed in conformity with the specifications above suggested, it is recommended, if this report be approved by the Iowa Section, that an effort be made to have a committee appointed by the American Water Works Association to investigate the subject and report.

In case this cannot be done, it is recommended that copies of this report be printed and distributed as widely as seems wise among the leading popular and technical magazines, State Boards of Health, Public Health Societies, Medical Associations, etc.

Bibliography. A bibliography is appended to this report giving all the references to papers on sanitary drinking fountains with which your committee is acquainted.

Respectfully submitted,

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